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| APPLICATION NO.   | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.       | CONFIRMATION NO. |
|---|-------------|----------------------|---------------------------|------------------|
| 10/632,176  | 07/31/2003  | Farrokh Ayazi        | 062020-1440               | 9833             |
| 24504   | 7590        | 05/10/2005           |                           |                  |
| THOMAS, KAYDEN, HORSTEMEYER & RISLEY, LLP<br>100 GALLERIA PARKWAY, NW<br>STE 1750<br>ATLANTA, GA 30339-5948 |             |                      | EXAMINER<br>KANG, DONGHEE |                  |
|   |             |                      | ART UNIT<br>2811          | PAPER NUMBER     |

DATE MAILED: 05/10/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

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|                              |                 |               |  |
|------------------------------|-----------------|---------------|--|
| <b>Office Action Summary</b> | Application No. | Applicant(s)  |  |
|                              | 10/632,176      | FARROKH ET AL |  |
|                              | Examiner        | Art Unit      |  |
|                              | Donghee Kang    | 2811          |  |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 23 February 2005.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-9, 18-28 and 36 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-9, 18, 20-28 and 36 is/are rejected.
- 7) ☒ Claim(s) 19 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 31 July 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some    \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Drawings***

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the limitation "a plurality of capacitive gaps and release a plurality of resonating elements..." in claim 36 must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

### ***Claim Rejections - 35 USC § 112***

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2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claim 36 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The newly added claim 36 is not supported by the disclosure.

***Claim Rejections - 35 USC § 102***

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

5. Claims 1 & 3-9 are rejected under 35 U.S.C. 102(a) as being anticipated by No et al. ("The HARPSS Process for Fabrication of Nano-Precision Silicon Electromechanical Resonators", IEEE Conf. Of Nanotechnology, pp 489-494, October 30, 2001).

RE claim 1, No et al. teach a method for fabricating micro-electro-mechanical system (MEMS) capacitive resonators, the method comprising (Fig.8):

Forming trenches in a substrate; conformally coating the substrate with an oxide; filling the coated trenches with the polysilicon; patterning the polysilicon; releasing a

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resonating structure derived from the substrate; and removing the conformally coated oxide. See also The HARPSS Fabrication Process section on pages 491-493.

Re claim 3, No et al. teach the releasing comprises separating the resonating structure from the polysilicon.

Re claim 4, No et al. teach the releasing comprises an isotropic silicon etching of the resonator.

Re claim 5, No et al. teach the filling includes filling out from sidewalls of the trenches.

Re claim 6, No et al. teach the removing includes forming a gap between the resonating structure and the polysilicon in a self-aligned manner.

Re claim 7, No et al. teach the gap is approximately less than 90 nm.

Re claim 8, No et al. teach the filling includes forming an electrode.

Re claim 9, No et al. teach the etching includes forming high-respect ratio trenches.

### ***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over No et al. in view of Ayazi et al. ("High Aspect-Ratio Combined Poly and Single-Crystal Silicon

(HARPSS) MEMS Technology", J. of Microelectromechanical Systems, Vol.9, No.3, September 2000).

No et al. teaches the method further comprising depositing nitride on the substrate ; patterning the nitride to isolate pads; and providing polysilicon to the patterned pads.

No et al. do not teach metallizing the pads. Ayazi et al. teach metallizing the pad (Fig.2) to form electrode bonding pads. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form metal on nitride patterned pads as taught by Ayazi in No's device in order to provide electrode bonding pads.

8. Claims **18 & 20-28** are rejected under 35 U.S.C. 103(a) as being unpatentable over No et al. ("The HARPSS Process for Fabrication of Nano-Precision Silicon Electromechanical Resonators", IEEE Conf. Of Nanotechnology, pp 489-494, October 30, 2001) in view of Lin et al. (US 6,413,793).

.Re claim 18, No et al. teach a method for fabricating micro-electro-mechanical system (MEMS) capacitive resonators, the method comprising (Fig.8):

forming trenches in a semiconductor substrate; conformally coating the semiconductor substrate with an oxide; filling the coated trenches with polysilicon, wherein electrode are derived from the polysilicon; forming release openings; and removing the conformally coated oxide, wherein a capacitive gap is formed, wherein a resonating element of the capacitive resonator is released.

No et al. do not explicitly teach the semiconductor-on-insulator (SOI) substrate. However, Lin et al. teach forming resonator structure on SOI substrate by removing oxide of the SOI substrate to prevent stiction by preventing the microstructure from falling down onto the substrate.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form MEMS resonator of No on SOI structure as taught by Lin since SOI structures prevents microstructure from falling down onto the substrate hence improving the micromachining process yield.

Re claim 20, No et al. as modified by Lin teach the forming release opening comprises anisotropically etching to an oxide layer of the SOI structure, such that the undercut of the resonating element is facilitated.

Re claim 21, No et al. as modified by Lin teach the filling includes one of filling the trenches with doped LPCVD polysilicon such that the electrodes are formed vertically and depositing and patterning doped LPCVD polysilicon.

Re claim 22, Noi et al. as modified by Lin teach the forming trenches includes one of deep reactive ion etching and regular reactive ion etching to an oxide layer of the SOI substrate.

Re claim 23, No et al. as modified by Lin teach the conformally coating include depositing a LPCVD high-temperature oxide of approximately less than 100 nanometers.

Re claim 24, No et al. as modified by Lin teach the conformally coating is scalable to correspond to a desired thickness of a lateral gap spacing for the capacitive resonator.

Re claim 25, NO et al. as modified by Lin teach the removing comprises an anisotropic plasma etching such that at least a portion of the oxide remains on sidewalls of the resonating element.

Re claim 26, No et al. as modified by Lin teach the releasing comprises exposing the SOI substrate to a solution HF:H<sub>2</sub>O to release the resonating element from a handle layer and the electrodes.

Re claim 27, No et al. as modified by Lin teach the forming trenches includes etching high-aspect ratio trenches.

Re claim 28, No et al. as modified by Lin teach the removing includes forming a gap between the resonating element and the polysilicon in a self-aligned manner.

***Allowable Subject Matter***

9. Claim 19 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

Prior art reference, taken along or in combination, do not teach or render obvious that depositing and patterning nitride, wherein the nitride provides protecting for the insulator oxide disposed on the pads and growing and removing a surface treatment



oxide, wherein the surface treatment oxide enables the reduction of the roughness of the sidewalls of the resonating element.

***Conclusion***

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Donghee Kang whose telephone number is 571-272-1656. The examiner can normally be reached on Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Donghee Kang  
Primary Examiner  
Art Unit 2811

dhk